Early Level 1b evaluation based on HIRS experience and AIRS Data Product Validation

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AIRS Early Validation for AIRS

- Early tests
  - Extremes test
  - Tuning test
  - Mirror coating test
  - Covariance test – Eigenvector test
  - Scan bias test
  - Noise test
  - Sun Glint test
  - Spectral stability test

AIRS Early Evaluations

- Extremes test
  - Purpose - Look for drifts in the data with time
  - Average the warmest 2% of observations and track with time
  - Average the coldest 2% of observations and track with time

- Tuning test
  - Purpose - Get an early look at tuning performance
  - Perform early tuning based on differences from NCEP model
  - Track with time stability
  - Compare with RAOB values when a sample is available
  - Compare tunings based on NCEP and ECMWF values

AIRS Early Evaluations Continued

- Mirror Coating Test
  - Purpose – Look for angle dependent problems caused by coatings
    - Scan mirror coatings polarizes the signal and rotates relative to the instrument
  - Cold clouds can reveal a scan bias caused by a mirror coating
  - All but the most opaque channels see the same temperature
  - Select areas with low temperatures, 210 (ie. High clouds)
  - Calculate the expected value by averaging unaffected channels
    - Coldest values are the least affected – mirror is warmer
  - Plot the channel difference from the average of unaffected channels
  - Look at deviations as a function of scan position
  - Calculate eigenvectors of the differences
  - If patterns exist
    - Use the measured mirror temperature to calculate emissivities

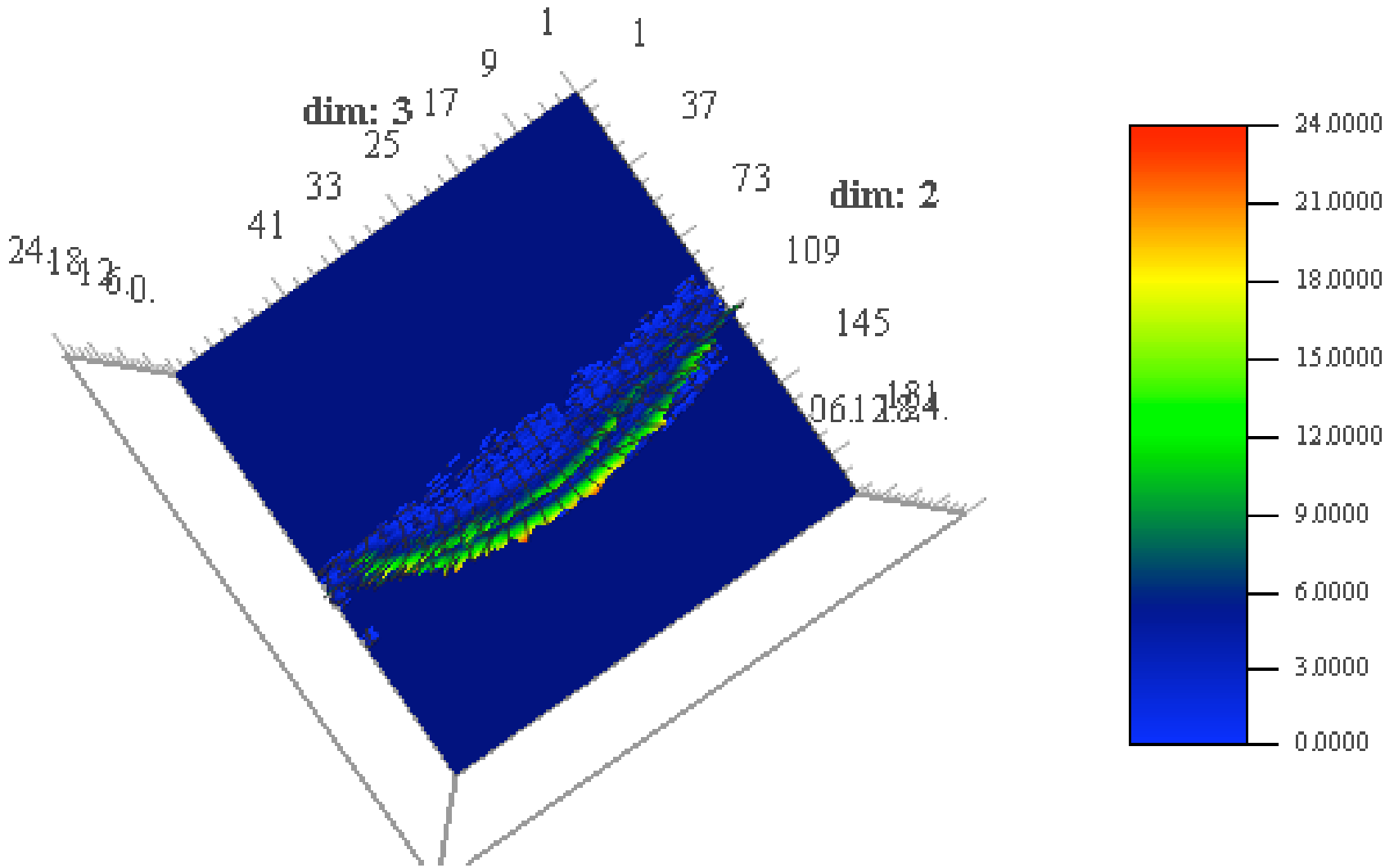
AIRS Early Evaluations Continued

- Covariance Test
  - Purpose – look for systematic differences between calculated & observed
  - The Covariances of measured and calculated radiances should agree
  - Select clear areas and calculate the covariance of the measured radiances
  - Using the forecast values, calculate radiances and then the covariance
  - Difference the covariances and display the result
  - If differences occur, investigate the cause
- Eigenvector Test – Equivalent
  - Calculate eigenvectors from clear data
  - Use to dominant ones to calculate PCS's from measured data
  - Multiply by the eigenvectors to reconstruct the measurements
  - Difference the measured and reconstructed values
  - Map the differences for channels with large departures

AIRS Early Evaluations Continued

- Scan Bias Test
  - Purpose – look for scan dependent biases
  - Select clear observations
  - Calculate radiances from the forecast/analysis using bias adjustment
  - Calculate radiances from the forecast/analysis without the bias adjustment
  - Difference the measured and clear values
  - Map the differences for each scan angle
  - Average over latitude bands and the globe for each scan angle
  - Compare the results
- Noise Test
  - Purpose – Establish the noise level in orbit
  - Compare adjacent clear spots to get the noise
  - Subtract along track values and cross track values separately
  - Calculate the mean and rms to get noise values
    - Note – along track mean should be zero

HIRS Histogram of the 1st principal component score as a function of scan position (dim: 3) and scaled value (dim: 2). Note double peak and dependence on scan position



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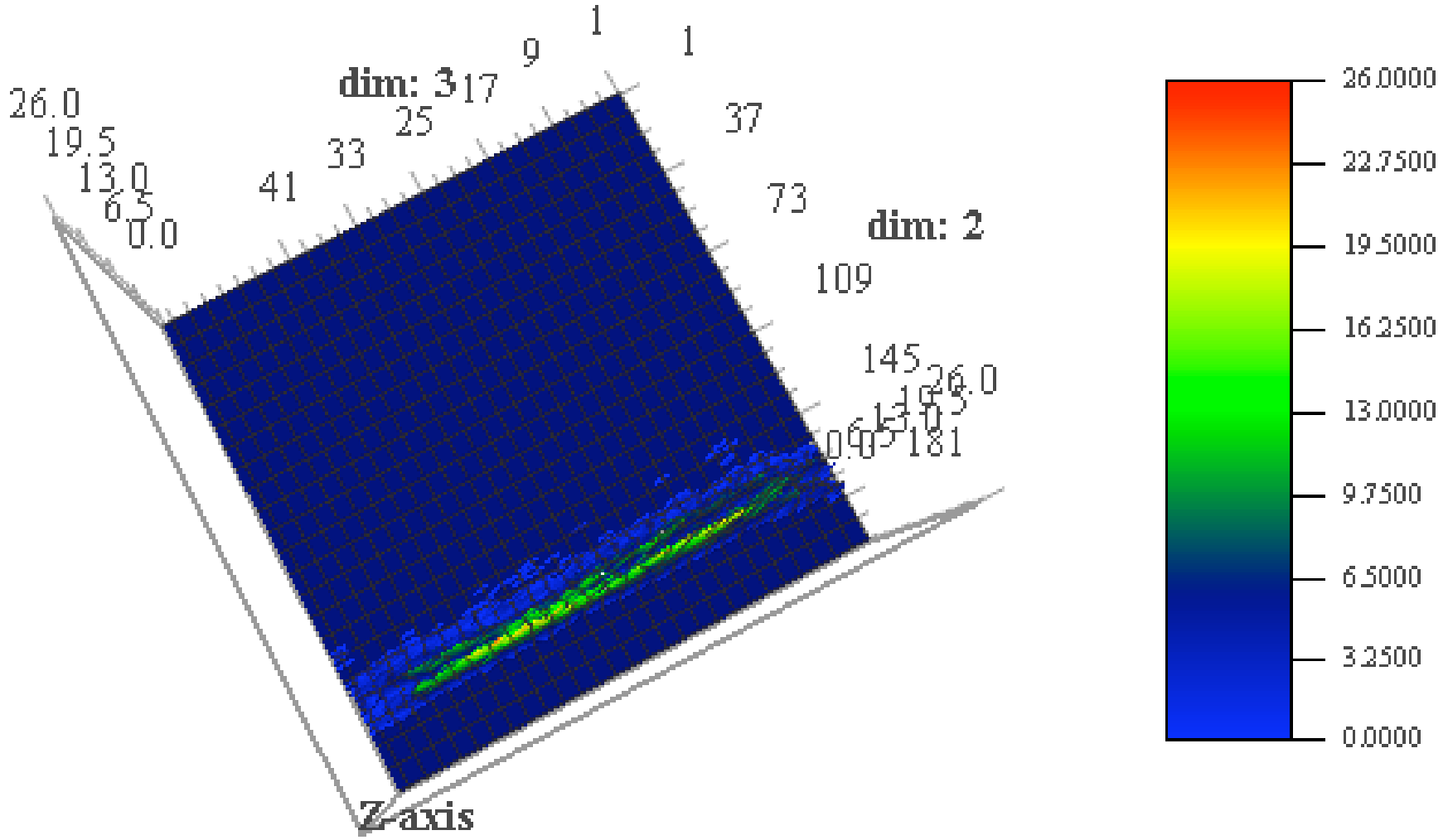
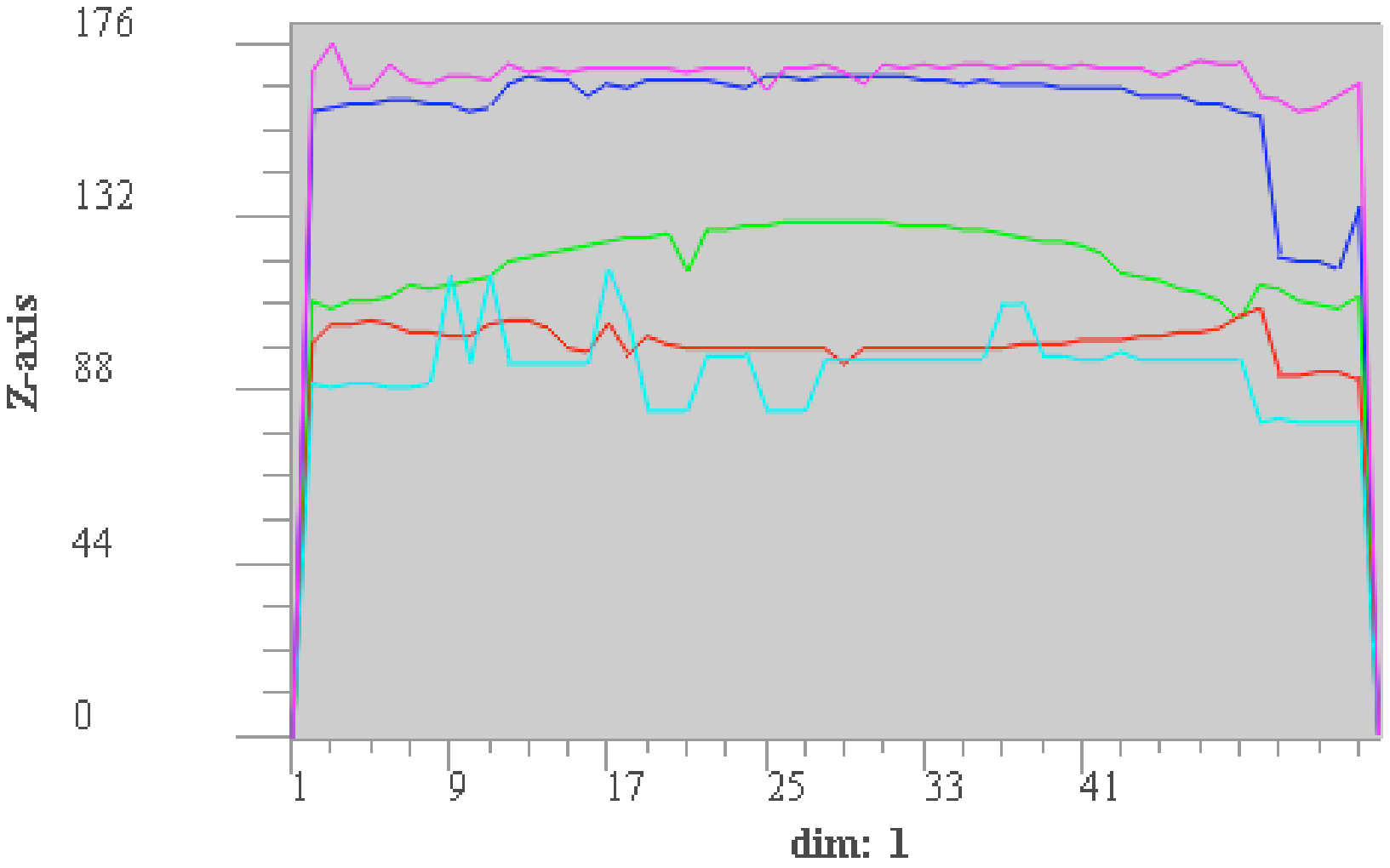
HIRS Histograms of the clear spot discriminator as a function of scan position (dim: 3) and scaled value (dim: 2). Slight dependence on scan position.



HIRS Scan dependent biases – purple is clear discriminate – light blue is latitude – others are 1st 3 PCS`s – x axis is scan position – vertical is scaled value of the mode



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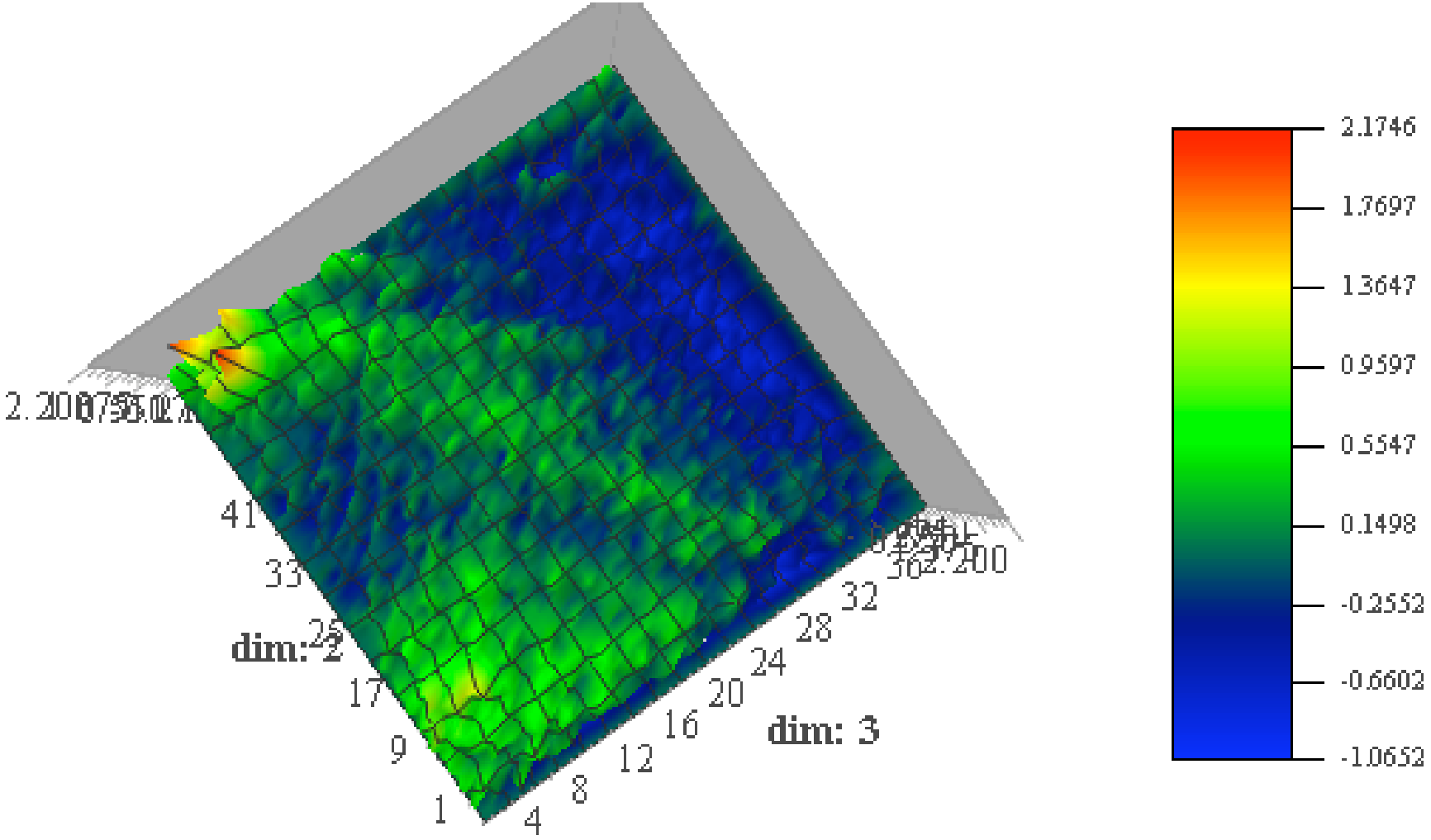
HIRS: Systematic Noise Chan. 16 Difference from microwave predicted value. Dim: 2 is scan position, dim: 3 is scan line.



Early evaluations Continued

- Sun Glint Test
  - Purpose - Establish the angles & channels affected by reflected solar radiation
  - Use clear data at night (SZA>96) to create coefficients to predict shortwave channels from longwave channels
  - Apply the coefficients to nighttime data over oceans to establish the error level
  - Apply the coefficients to daytime data over oceans to get solar effects
  - Plot a typical orbit to get the expected value
- Step 2
  - Get the forecast wind speed
  - Plot the difference as a function of wind speed
  - Do the same for land except for the wind speed

Early evaluations Continued

- Spectral stability Test
  - Purpose – detect shifts in frequency
  - Select pairs of channels that are on opposite sides of a spectral line and have about the same radiance – one pair for each module
  - Calculate the expected temperature difference over a tropical atmosphere
  - Use clear data (not necessary for high peaking channels) to calculate the difference
  - Compare the expected and measured values
  - Plot the difference as a function of time
  - Alternative
    - Calculate principal component scores for measured and calculated values
    - Look at the differences

AIRS Validation Plans

- A trial version is set up on a website
- Orbit-net.nesdis.noaa.gov/crad/ipo
- Capabilities
  - View matches with AIRS and HIRS
  - View ACARS reports
  - View monthly statistics TOVS up through NOAA 14
  - View data as a function of time, angle etc.
  - View the HDF format specification

Correlative Data for Validation

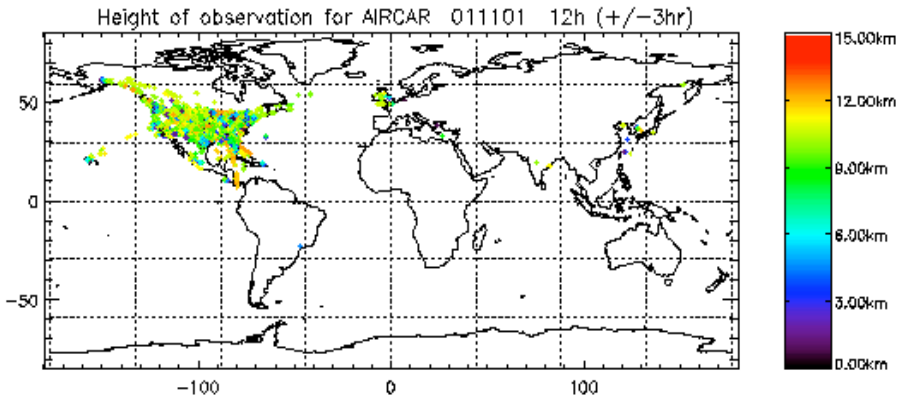
- Current
  - Radiosondes
  - Buoys
  - Aircraft
  - Hourly surface observations
  - Other satellites
  - Forecasts/analysis
- Planned
  - GPS moisture
  - Ozone
  - Upper atmospheric temperatures
  - ARM data

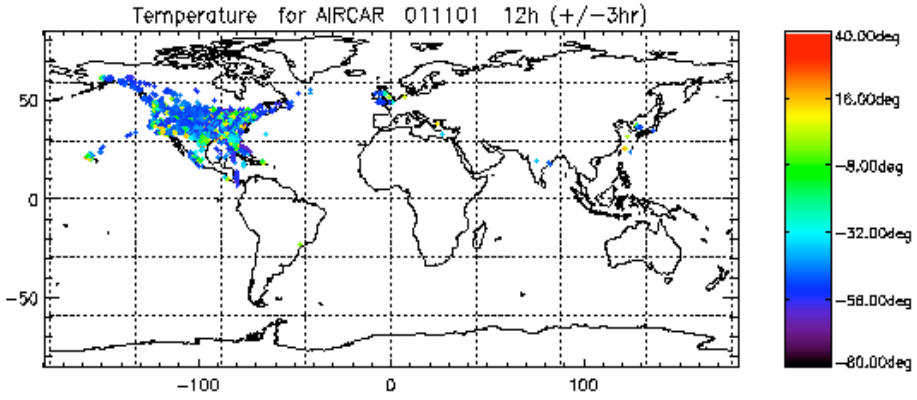
Data - continued

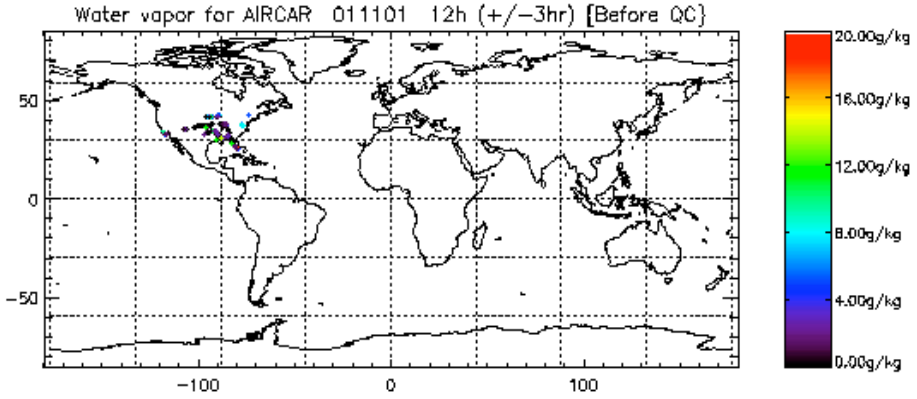
- Moisture
  - Current upper atmospheric measurements should be more accurate than radiosondes even though the same sensor is used due to compression/heating
  - Current aircraft moisture may be difficult
    - Data are available
    - Uses the Viasalla sensor
    - Ages with time and need calibration
    - Adjusted data available from NCAR, but online data has issues
  - Starting to deploy an advanced sensor
    - Better upper atmospheric measurements
    - Uses a small absorption cell

Aircraft Reports

- The next slide shows the aircraft repots at 1200 Z (ACARS)
  - Some water vapor measurements appearing
- Following slide shows the European reports at 1200 Z (ASDAR)







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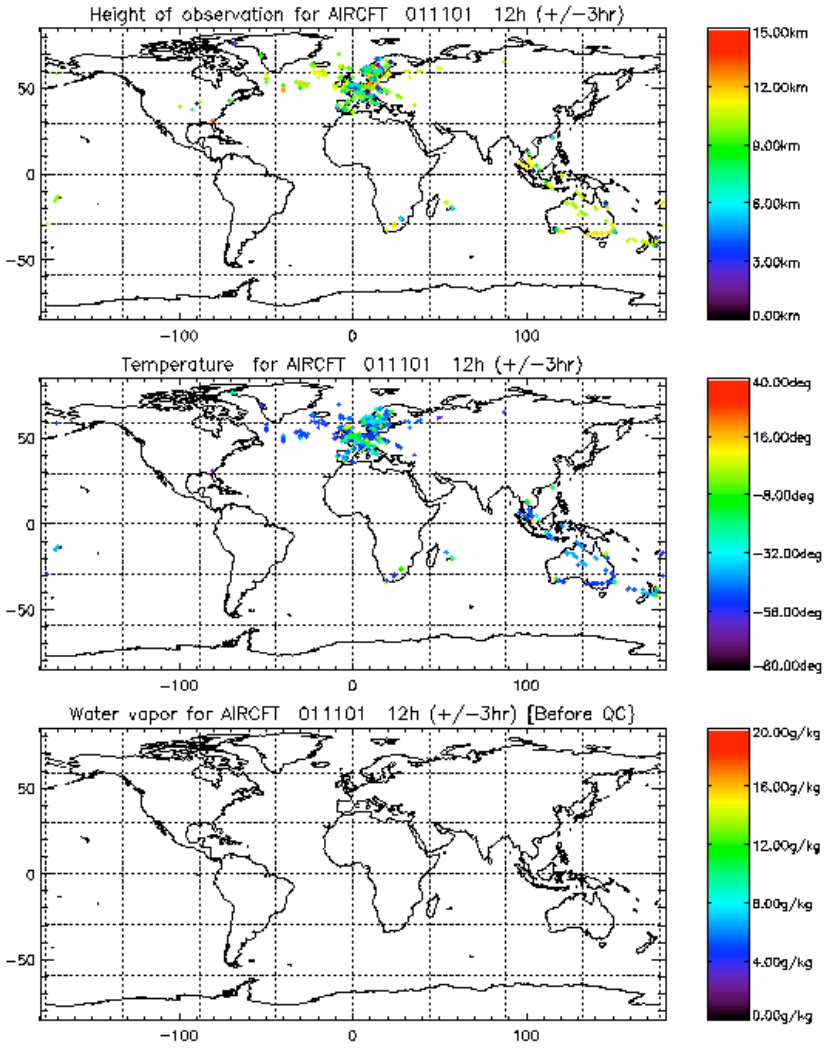

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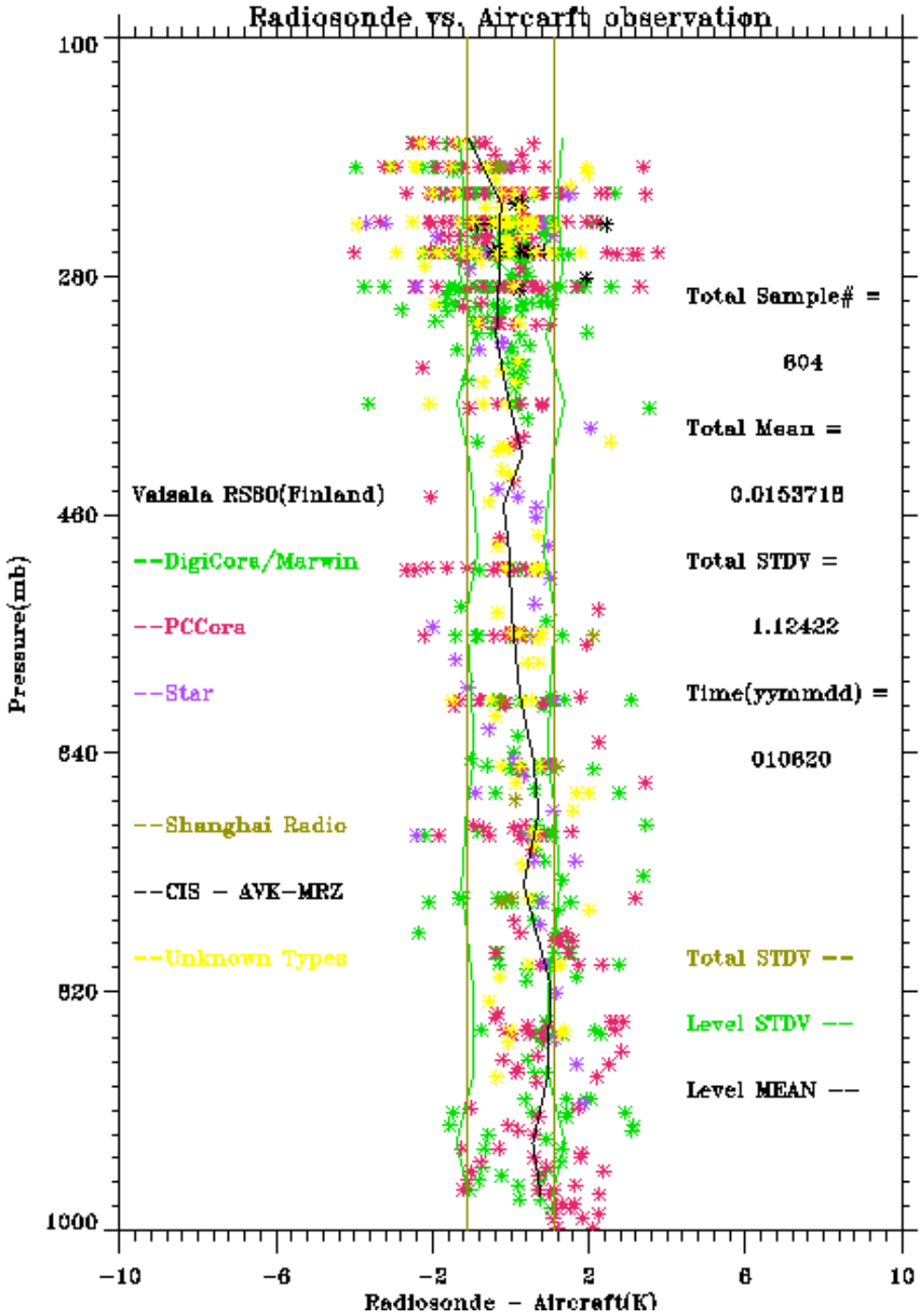
Radiosonde files

- Radiosonde data
- Hourly surface temperatures
- SST if available
- AIRS data
- AIRS retrievals
  - Bias adjusted
  - Unadjusted
- Aircraft reports

Current Tasks

- TEAM exercise
  - Supplement radiosonde information to complete a profile
    - This means adding the unknown data – not data from other truth
  - Put the team match files in our data base
    - We are doing a match but want the official team version
- HIRS prototype for tuning algorithm
  - Status - running
  - Complete by Dec 2001
- Comparison of radiosonde with ACARS reports
  - Data are being collected and results are available
  - Aircraft use a Viasalla sensor
  - Results show a level dependent bias
  - Radiosondes start warm but cool with height



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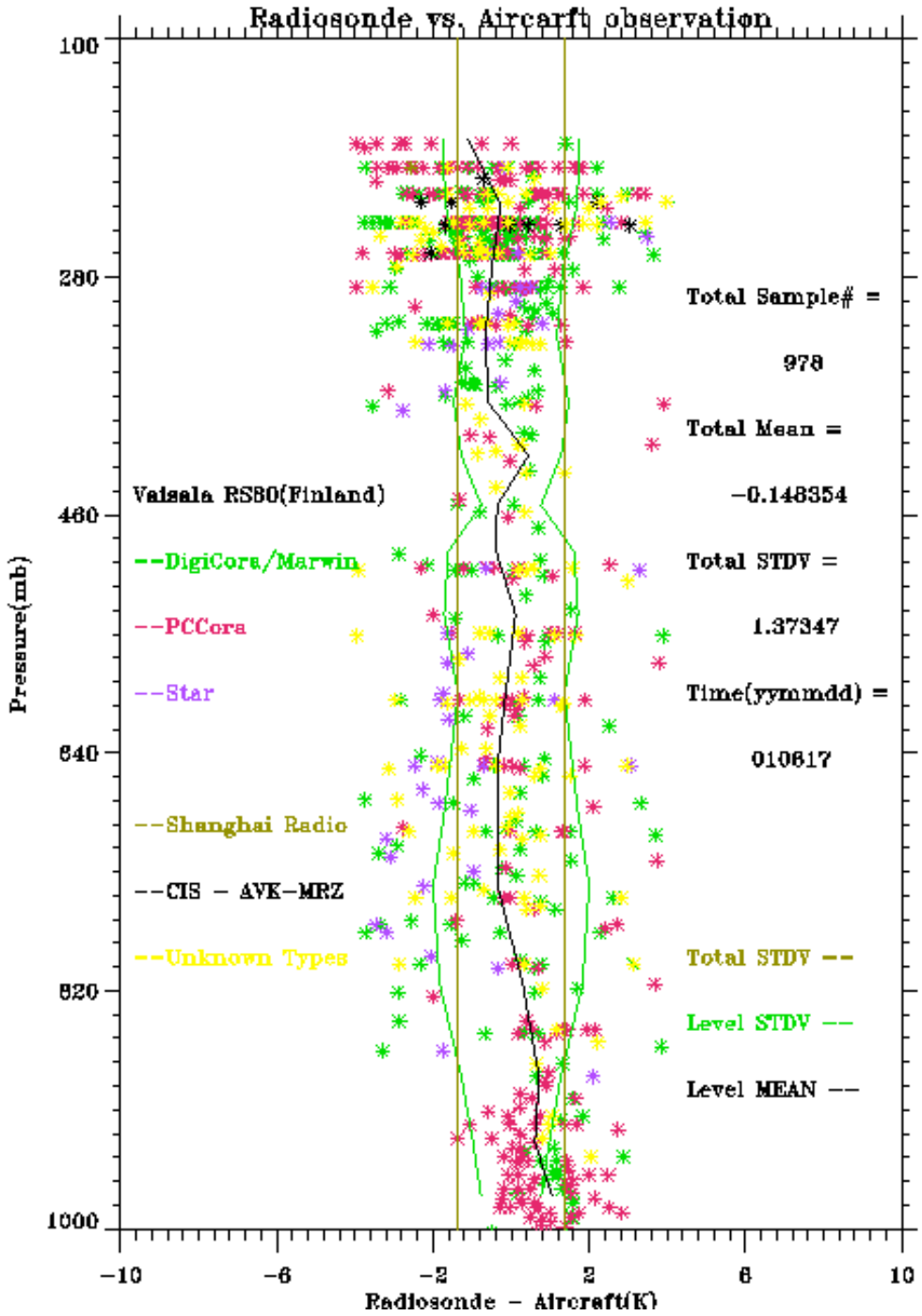

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Current Tasks Continued

- Use of GPS data
  - Place data in match files with closely collocated radiosondes
  - Format is set but no data yet
  - Like to get more than 10 (15) US matches
  - Compare total water vapor and
    - Adjust the radiosonde or
    - Reject it
- Working with Jim Yoe
- We will place other data in our match file
  - The sooner we can details about a format, the better
  - Might be useful to look at our format on our web site